Joint Virtual Battlespace

Ms. Rani Hobgood

703 704 1824

rani.hobgood@nvl.army.mil

- JVB Overview

- JVB Support to FCS Procurement

- JVB – A SMART Tool

JVB Description

- JVB IS NOT A MODEL!!
- JVB is a Simulation Environment Supporting Variety of Aggregate, Entity-level and MITL/HITL Simulation Functions
- Enables the Capability to Measure the Combat Effectiveness of Information and It's use
- Tool Supporting Transformation and Acquisition Decisions in a Joint Command, Control, Communications, Computers, Intelligence, Sensors and Reconnaissance (C4ISR) Environment
- Shares Standard Algorithms, Data and Environment (Terrain, Weather)
- Supports System of System Trades and Data Collection for Analysis
- Component Based Framework Supports the FCS Concept of System of Systems
  - Shift from the Current M&S Focus on Individual Systems

JVB Mission

Mission:

To Provide a Modeling and Simulation Environment to Support Army Transformation and Army SMART Decisions in a Joint C4ISR Framework.

Current Objective:

To Build the M&S Environment to Support Acquisition Decision for the FCS Program.

- January 2001: ASA(ALT) Directed PEO IEW&S(JPSD) to Build the JVB

- October 2001: ASA(ALT) Recognized JVB's Potential to Support FCS Acquisition Process

  – Reaffirmed Army Need for JVB Capability to Support OF S&T Activities

- November 2001: Demonstrated First Instance of JVB Environment to OFTF

  – Conducted OF Survivability Study

- December 2001: FCS and TRAC Initiated Plans for C4ISR Study to Support FCS Milestone B

  – JVB Identified as a Required Capability

- Early February 2002: JVB Demonstrated to DUSA(OR)

- February 2002: JVB Adjusted Development Path and Schedule to Ensure an Instance of JVB Capability Will be in Place to Answer C4ISR Issues Proposed in the AOA

- June 2001- April 2002: Dr. Andrews, DASA-RT, Recognizes JVB on Three Occasions While Presenting Testimony to Congressional Committees
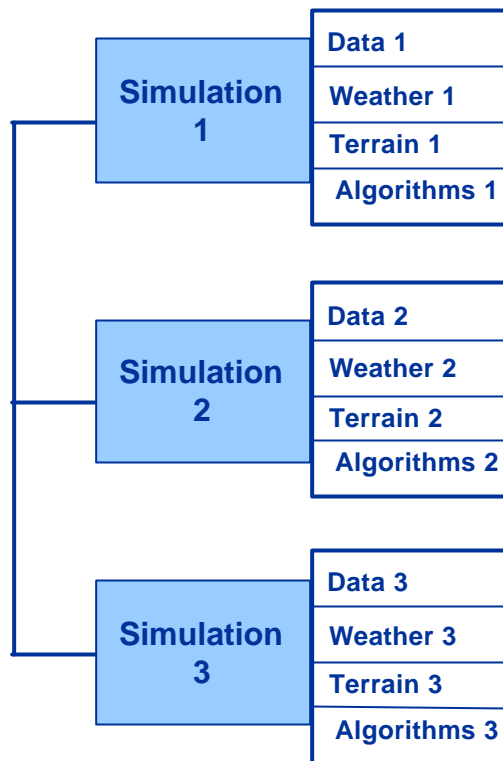
- Dr. Andrews, DASA-RT, Recognizes JVB on three occasions while Presenting Testimony to Congressional Committees.
    - 5 Jun 01 to Senate Armed Services Committee - Subcommittee on Emerging Threats and Capabilities
    - 26 June 01 to House Armed Services Committee - Subcommittee on Military Research and Development
    - 10 Apr 02 to Senate Armed Services Committee - Subcommittee on Emerging Threats and Capabilities

- **Advanced Simulation: … the Joint Virtual Battlespace, (JVB)** Program, is an Enabling Technology for Evaluating How FCS Contributes to the Total Capability of the Objective Force, and How the Objective Force Plays in a Joint Force. JVB, Combined With Virtual Prototyping, Also Could Provide an Effective Means for Performing Operational Test and Evaluation Without the Need for Numerous Hardware Test Articles. This Could Result in Significant Time and Financial Savings in the Army Acquisition Process.

- Bring Together World Class Team of Experts

  - Government Labs

  - Army Organizations

  - Joint Representatives

  - Contractors

- Develop a Flexible, Extensible M&S Framework

- Integrate Best Available SMART Tools

- Support Objective Force Task Force, PM FCS and TRADOC to Identify Issues and Conduct Experiments

- Provide a Robust Set of Analysis Tools to Collect and Analyze Data, MOEs and MOPs

- Provide Data to PM FCS and Army Analysis Community to Support Acquisition, Force Design and Employment Decisions
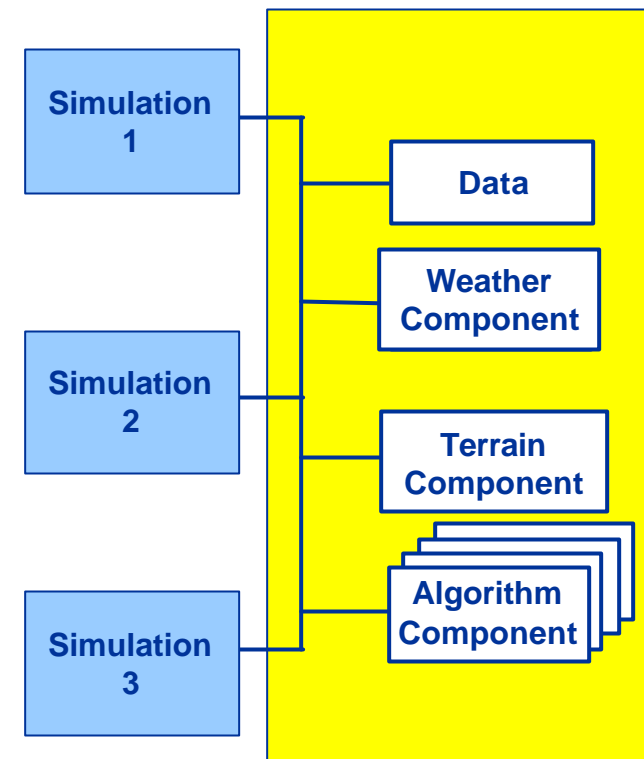
JVB Integration Approach

Current

Simulation 1
- Data 1
- Weather 1
- Terrain 1
- Algorithms 1

Simulation 2
- Data 2
- Weather 2
- Terrain 2
- Algorithms 2

Simulation 3
- Data 3
- Weather 3
- Terrain 3
- Algorithms 3

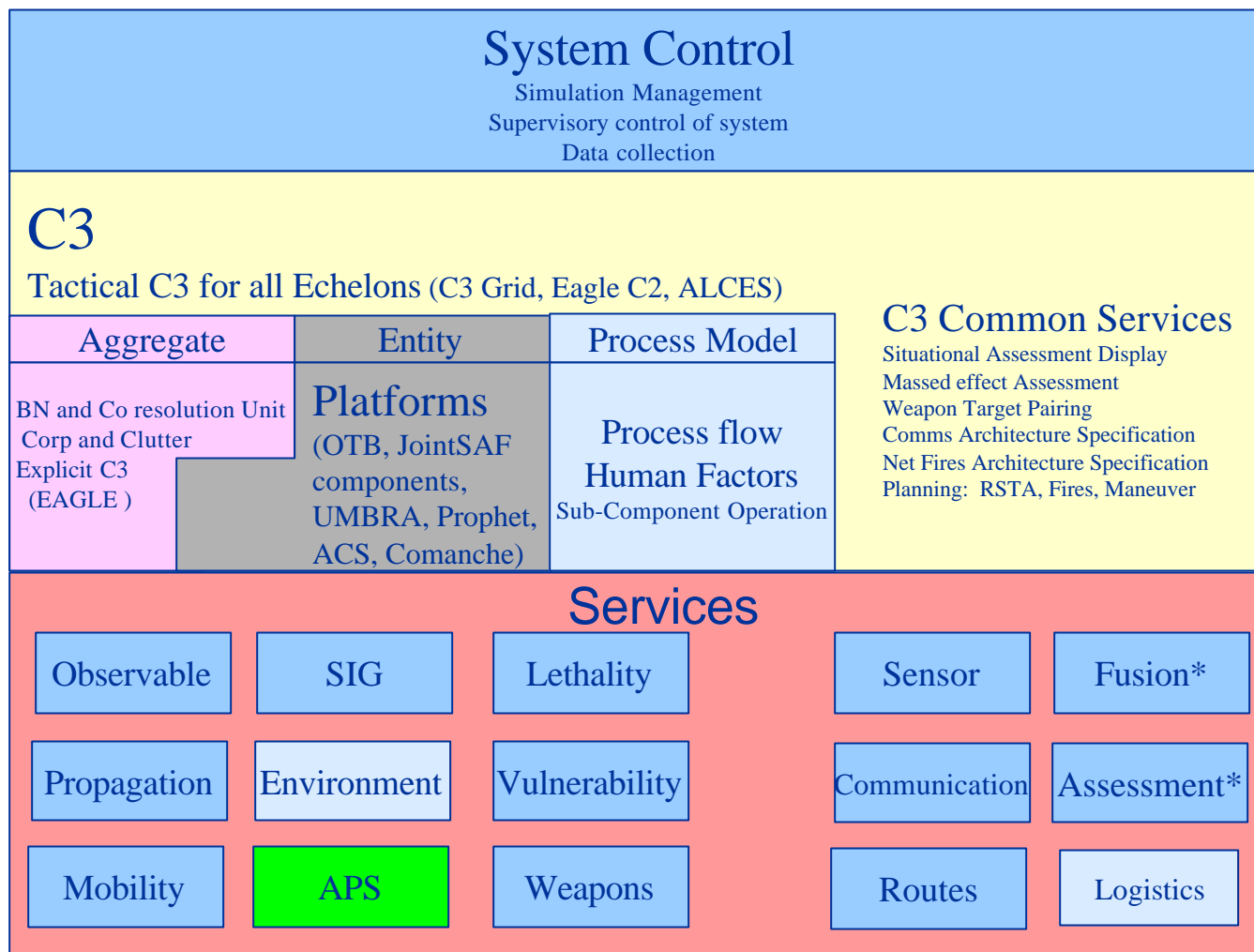Precoordinate to ensure everything is as Consistent as possible
Post coordinate to interpret inconsistencies between models

JVB

Simulation 1

Simulation 2

Simulation 3

- Data
- Weather Component
- Terrain Component
- Algorithm Component

All simulations use Consistent data and algorithms

JVB Objective Software Architecture

System Control

Simulation Management
Supervisory control of system
Data collection

C3

Tactical C3 for all Echelons (C3 Grid, Eagle C2, ALCES)

Aggregate	Entity	Process Model
BN and Co resolution Unit Corp and Clutter Explicit C3 (EAGLE)	**Platforms** (OTB, JointSAF components, UMBRA, Prophet, ACS, Comanche)	Process flow Human Factors Sub-Component Operation

C3 Common Services

Situational Assessment Display
Massed effect Assessment
Weapon Target Pairing
Comms Architecture Specification
Net Fires Architecture Specification
Planning: RSTA, Fires, Maneuver

Services

Observable	SIG	Lethality	Sensor	Fusion*
Propagation	Environment	Vulnerability	Communication	Assessment*
Mobility	APS	Weapons	Routes	Logistics

Available

FY 03

TBD

*Limited implementation based on requirements- functional place holders until models are validated and integrated

JVB Conceptual Framework
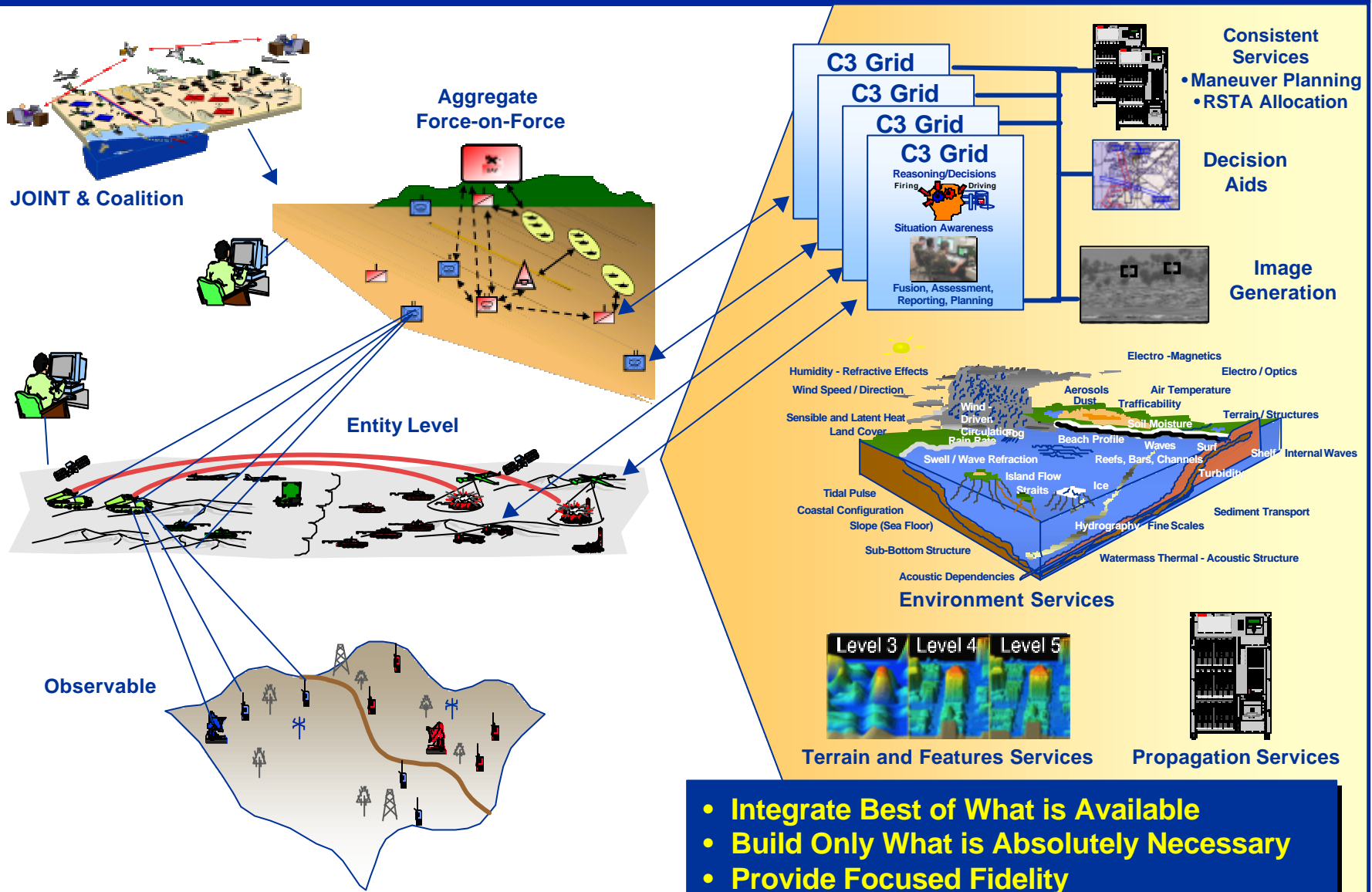
- **JVB Overview**
- **JVB Support to FCS Procurement**
- **JVB – A SMART Tool**

Overarching Study Issue: How Does the Objective Force Commander Exercise Battle Command, Enabled by the C4ISR Architecture?

JVB Gives Decision Makers the Capability to Measure the Combat Effectiveness of Information and how It is Used
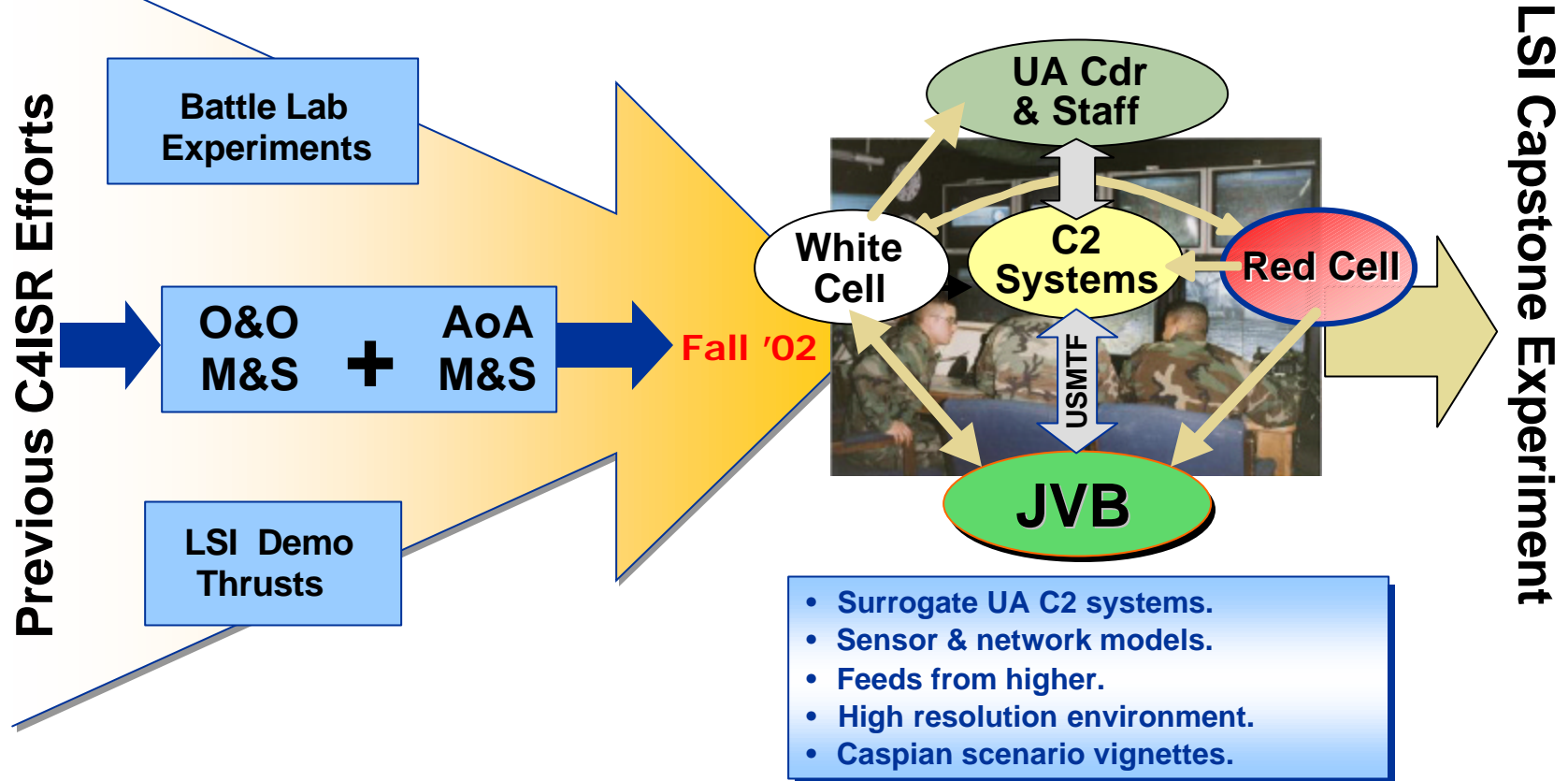
In the TRADOC-Approved Scenario, JVB Will:

• Implement FCS C4ISR Procedures and TTPs

• Collect Data Supporting Analysis of the C4ISR Procedures and TTPs

  - C4ISR Capabilities and Limits

  - Force Effectiveness

• Provide the Link for Large and Small Scale Units to Work Together in a Common Battlespace

Unit of Action
C4ISR Analysis Strategy (TRAC)

UA C4ISR Experiment Objectives
- Serve as a Major Integrating Event for FCS/UA C4ISR O&O and OA.
- Assess CDR's Ability to Command UA.
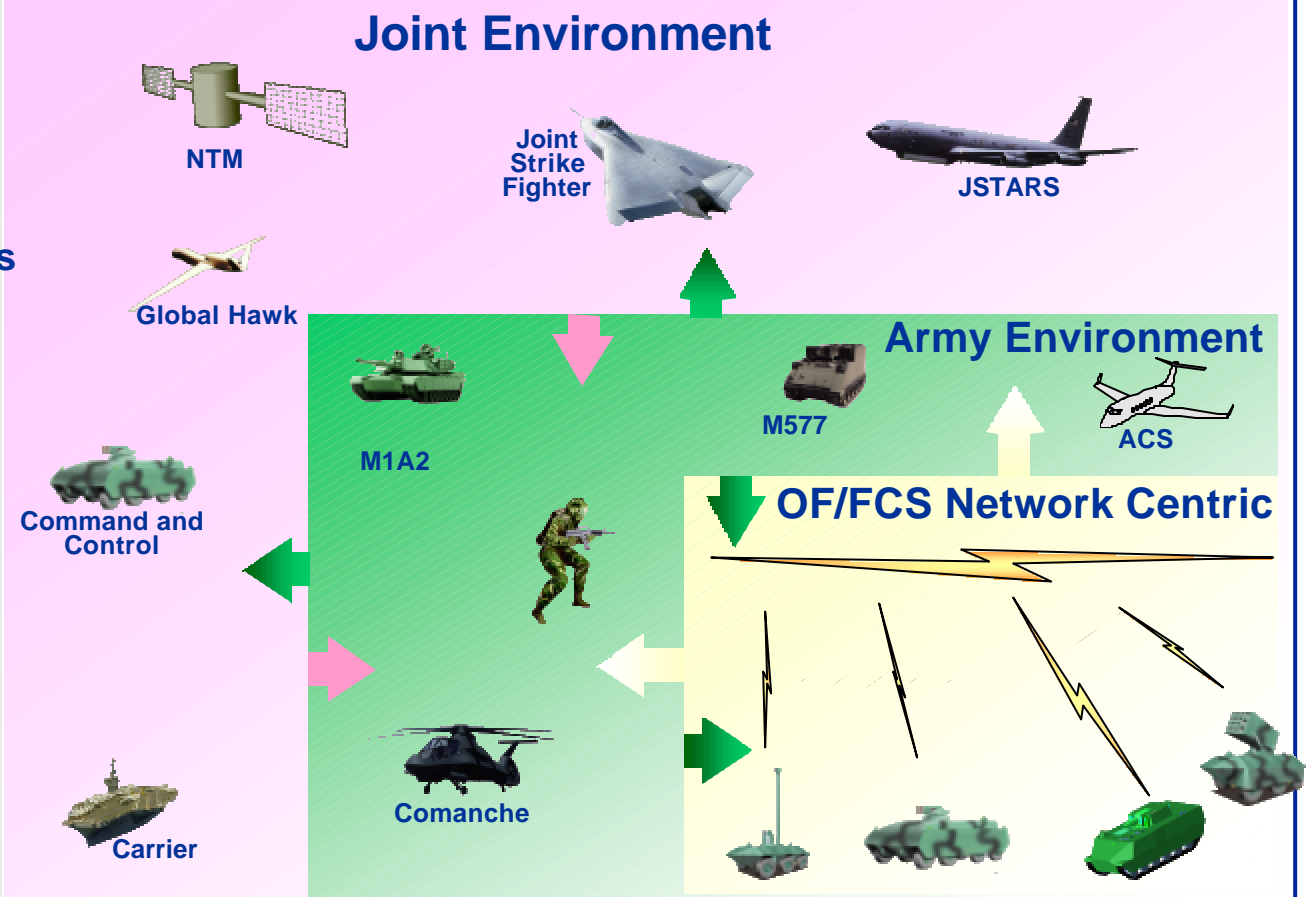- Assess C4ISR Capabilities to Enable the UA O&O.
- Collect DTLOMS Insights.

Previous C4ISR Efforts

Battle Lab Experiments

O&O M&S **+** AoA M&S

Fall '02

LSI Demo Thrusts

White Cell

UA Cdr & Staff

C2 Systems

Red Cell

USMTF

JVB

LSI Capstone Experiment

- Surrogate UA C2 systems.
- Sensor & network models.
- Feeds from higher.
- High resolution environment.
- Caspian scenario vignettes.

- **JVB Overview**
- **JVB Support to FCS Procurement**
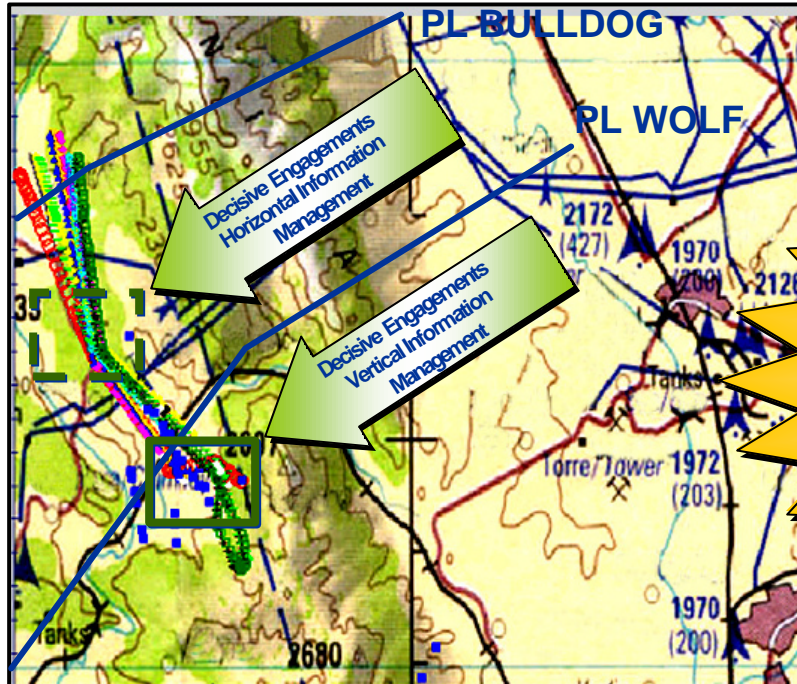- **JVB – A SMART Tool**

JVB Baseline Capabilities

SMART
(Simulation & Modeling for Acquisition, Requirements and Training)…

…Tool To Support The Objective Force and
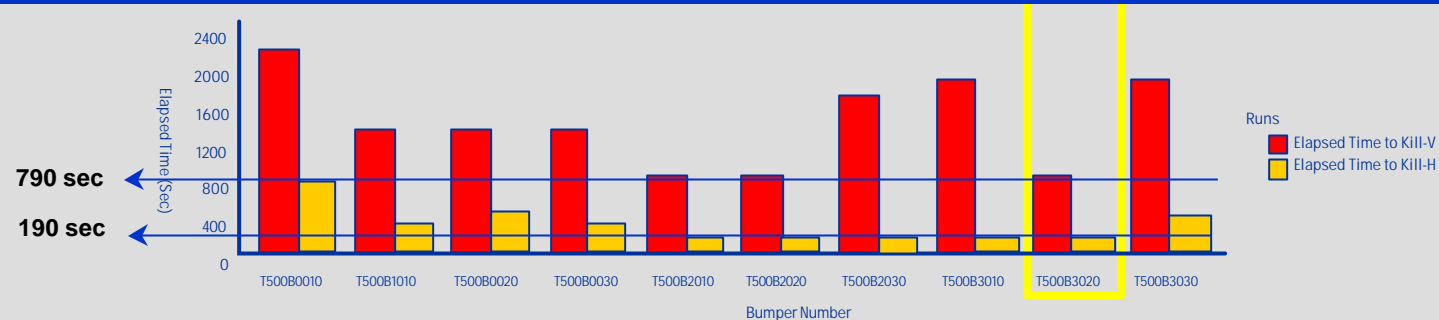**Future Combat System**

JVB Design Includes:

- **Joint Forces**
- **Legacy Forces**
- **Objective Force**
- **Future Combat Systems**
  - **C3**
  - **ISR**
  - **Robots**
  - **New Weapons**
- **Logistics**
- **Dynamic Weather**
- **Dynamic Terrain**
- **High Fidelity Terrain**
- **Certified Data**

Joint Environment

NTM

Joint Strike Fighter

JSTARS

Global Hawk

Army Environment

M1A2

M577

ACS

Command and Control

OF/FCS Network Centric

Comanche

Carrier

JVB Unique Capabilities

PL BULLDOG

PL WOLF

Decisive Engagements Horizontal Information Management

Decisive Engagements Vertical Information Management

Only M&S Tool That Gives Decision Makers the Capability to Measure the Combat Effectiveness of Information and It's Use Across all Echelons

First Detection to Engagement, Vertical versus Horizontal

790 sec

190 sec

Elapsed Time (Sec)

2400
2000
1600
1200
800
400
0

Runs
Elapsed Time to Kill-V
Elapsed Time to Kill-H

Bumper Number

T500B0010 T500B1010 T500B0020 T500B0030 T500B2010 T500B2020 T500B2030 T500B3010 T500B3020 T500B3030

JVB Support to Army Transformation

- JVB Enhances Existing Army M&S to Address OF C4ISR Issues

- Integrates Existing M&S Components That can be Extended and Enhanced to Assist in the Development of AT Concepts

- JVB Will use AMSAA-Certified Performance Data & Validated Physical Models in a TRAC-Approved Scenario With TRADOC DSCINT-Approved Threat

- JVB Architecture Will Enable us to:

  – Represent Specific Communications Network Performance

  – Evaluate Various C2 Configurations and Their Dissemination of Information, its Policies and Procedures

  – Maintain Situational Awareness Down to Each Vehicle

  – Allow Commander's Input

  – Make Quick Changes for Comparison of the Effectiveness of New "FCS Like" Tactics, Techniques, and Procedures

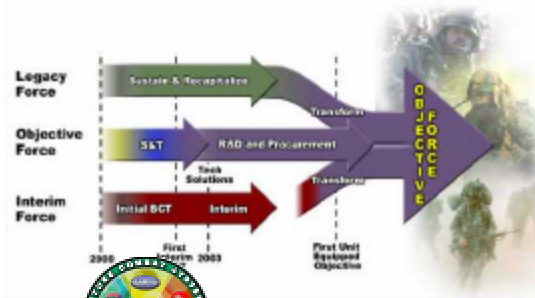# Joint Virtual Battlespace
Team and Partners

MANSCEN
- NBC Environment
- Obscurants

JPSD
- PM FCS Support
- Leverage ACTD's
- Joint C4ISR
- Integrated Analysis Tools
- Integration & Evaluation Center

STRICOM
- High Fidelity Live-Virtual-Constructive
- Semi Automated Forces

Sandia National Lab
- Robotics
- Sustainment/Reliability
- Human Factors
- Acoustics

Army Research Laboratory
- Human Workload
- Acoustics

CECOM
- Night Vision Simulations
- Comms Model

Los Alamos National Lab
- Force Structure

JFCOM
- Joint C2 & Simulation Support

COE ERDC
- Terrain/Weather
- Mobility
- Seismic

DOE Labs
- Lethality/Survivability

TRADOC TRAC-Leavenworth
- Force-on-Force

ASA(ALT)
- Army S&T Investment
- Guidance

DMSO
- HLA Standards
- Enviro. Fed

AMSO
- M&S Policy
- SMART

AMC
- **RDEC Federation**

TRADOC
- MMBL
- TRAC Ft Lee
- FPBL

> **Standard, Flexible, Extensible Architecture Allows Integration of Models from Subject Matter Experts to support Army Transformation**

Legacy Force — Sustain & Recapitalize
Objective Force — S&T — R&D and Procurement
Interim Force — Initial BCT — Interim

ornl

A Common FOM

- JVB and Joint Synthetic Battlespace (JSB - USAF)
  - Required to Support Acquisition of New Systems
  - Facilitate Interoperability of Joint Systems
  - HLA Based Distributed Simulation Environments
- Programs are Diverging Through Evolution of Requirements
- Facilitate Reuse and Adoption of Common Architectural Approaches
  - Component-based Architecture With Same Class Components
  - Aerial Common Sensor (ACS)/JVB Baseline Provided to JSB
- Defense Modeling and Simulation (DMSO) Sponsored Initiative to Facilitate Convergence of JVB and JSB
  - Facilitate a Truly Joint Interoperable Simulation Environment.
  - Focus on a Common Federation Object Model (FOM) - ACS
  - Common Approach
  - Common Set of Tools
  - Integration of Simulation Components of Both Systems
- Will Serve as the Foundation for Joint/Coalition Interoperability (Joint Distributed Engineering Plant (JDEP) and the Coalition Interoperability Simulation Environment (CISE)

- JVB Will:

  – Support Army Transformation Acquisition Decisions

  – Provide Authoritative Joint C4ISR Environment for Acquisition, Analysis and Experimentation

  – Provide Flexible Environment to Integrate Test and Evaluation Models

  – Support Requirements, Technical Tradeoffs (What-If Analyses to provide insight for S&T investments) and Interoperability Studies

  – Support O&O and TTP Development

JVB Value to the Warfighter

- **Architecture Provides**
  - Common Synthetic Battlespace
  - Component Based Environment
  - Information Driven

- **Reduces Development Time**
  - Integrate Mature Technologies
  - Early Experimentation
  - Requirements Development
  - CONOPS/TTPs Refinement
  - Trade-Off Studies

- **Enhances Quality**
  - Re-use Partners' Authoritative Models
  - Early Concept Evaluation in Realistic Environment
  - Flexibility For System Modifications

- **Reduces Costs**
  - Engineering Design Through Simulation
  - Streamline Development Process

- **Accelerates Fielding of Obj. Force Systems**

- **Enables Joint Interoperability (System of Systems)**

- **Underscores Warfighter's Logistic Challenge (Tooth to Tail Ratio)**

Focused to Meet Objective Force and Future Combat System Schedule and Milestones

- Experiments Provide Data Supporting Analysis of Critical Army Issues

  - Use of information in the battlespace

  - Force Structure

  - Equipment Benefit to Warfighter

  - How to Fight with New Equipment

  - Logistics Impacts

- Only Army Architecture Designed to Support Network Centric Warfare Experiments and Evaluation from JTF to Individual Systems

JVB Component Functionality

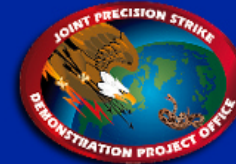|	JVB Component	Functionality
Simulation Management and Analysis	hlaControl	Creates and manages federation execution
	Scenario Definition	Generates the scenario file used by hlaControl to initiate a JVB scenario run
	hlaResults	Data management system used to collect, store, retrieve and playback federation data
	Analysis Tool (hlaEval)	Analyzes simulation results; supports build, store and display results of queries
	FCSView	Provides a 3-D visualization of a federation execution including terrain features, entities, sensor area of interest (AOI), detections, routes, and detonations
	Command and Control View (C2View)	Provides a plan view display or graphical, two-dimensional view, including object state data, of a federation execution

JVB Component Functionality

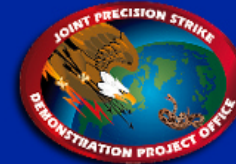| JVB Component	Functionality
Grid Java RTI Framework	Provides an abstraction layer between the federate application logic and the RTI
Rule-driven Infrastructure	Models C2 node process, bridging OTB and Eagle, by translating Eagle unit tasking into platform commands
The Battalion Federate [Tactical Unit of Action (TUoA)]	Issues high-level C2 tasking to Company federate
The Company Federate [Operational Unit Cell (OUC)]	Acts directly or tasks platoon units in response to situation or Battalion direction
The Platoon Federate [Functional Unit Cell (FUC)]	Responds to situation state and Company direction in controlling the behavior of platform and lower level entities
Aggregate Definition Service (ADS)	Creates and reports a perceived operational picture of variable quality that provides the context for C2 decisions implemented in the echelon based federates
Message Transceiver Service (MTS)	Models radio communications for the federation execution
Human Performance Model (HPM)*	Tracks and analyzes the human response to activity occurring within the C3 Grid
Dynamic Organization Service (DOS)	Describes tactical organizations by command and functional structures
Battlefield Geometry Service (BGS)	Generates battlefield geometry objects representing a given area or a segment, simulated field of view, Area of Interest (AOI), and battlefield lines
Networked Fire Service (NFS)	As a component of the targeting process, optimizes the weapons/target mix based on cost/benefit, timeliness, and weapon effectiveness
Organic Connection Service (OCS)	Translates between groups of component interactions, providing an abstraction layer between C3 Grid component interactions and the rest of the architecture
Mobility Server (NRMM) *	Provides NRMM based limitations of ground platform speeds
Route Planning Service (RPS) *	Provides NRMM based limitations of ground platform speeds

Tactical Command, Control and Communications (C3)

JVB Component Functionality

	JVB Component	Functionality
Platforms	Eagle	Models operational-level ground and air-ground combat operations using aggregate-level military units and explicitly representing C2 processes
	System Laydown and Emitter (SLE)	A pseudo-disaggregation model that publishes platforms, radios, and radars based on Eagle aggregate units
	One Semi-Automated-Forces (ONESAF) Testbed Baseline (OTB)	Creates and controls platform entities on the simulated battlefield
	UMBRA *	Models unmanned ground vehicle (UGV) and unmanned aerial vehicle (UAV) platforms
	Remote Piloted Vehicle (RPV) *	human control interface for a representative simulated Tactical UAV (TUAV) system providing both pre-mission planning and tactical situational awareness
	Rogue Warrior *	Human-in-the-loop extension of FCSView
	Observable Server *	Provides observable signature data for all platforms in the JVB federation

JVB Component Functionality

JVB Component	Functionality
Simulation Services	
Acoustic/Seismic Propagation *	Provides sound radiation and vibration frequencies between federation objects (represented sensors, emitters, and target platforms) to each respective sensor component
EO/IR Propagation *	Computes the propagation of entity emissions to a specific call of sensor systems
RF Propagation *	Provides IMINT/ELINT/COMINT radio frequency links between simulated objects representing sensors, emitters, and target platforms
Acoustic Sensor *	Models acoustic sensor behavior
Seismic Sensor *	Models seismic sensor behavior
EO/IR Sensor *	Models electro-optical and infrared sensor behavior
RF Sensor *	Models IMINT, ELINT, and COMINT sensor behavior
Paint the Night (PTN) *	Provides a high resolution EO/IR scene of a target vehicle as input to a sensor system display for human-in-the-loop consideration

JVB Component	Functionality
Effects Nuclear, Chemical, Biological, Radiological (NCBR) *	Models NCBR effects
Lethality/Vulnerability Server *	Generates damage reports for every weapon fire / detonation event pair
Missile Server *	Performs BEWSS/IDEAAS based missile behavior modeling